



AUSTRALIAN CITRUS TO SOUTH KOREA, CHINA AND THAILAND

PEST MANAGEMENT, ORCHARD REGISTRATION, AND PACKING HOUSE MEASURES

Version 3 - Revised November 2020

1. GROWER RESPONSIBILITIES

1.1 Orchard hygiene—all regions, all countries

All growers must:

- maintain general weed control
- ensure that orchards are free from tumbleweeds, packaging and other objects.

1.2 Pest Management (IPM)—all regions, all countries

All growers must implement an IPM program. This includes:

- conducting monthly monitoring (and record keeping) for pests and diseases from December until harvest (see section 1.3 for more details)
- applying appropriate in-field (chemical or biological) controls for pests and diseases (as required)
- maintaining a spray diary
- maintaining product labels for agricultural chemicals.

1.3 Pests and disease monitoring

As part of the IPM program, growers must conduct monthly monitoring (and keep records) for the pests of concern to South Korea, China and Thailand. Growers may conduct monthly IPM monitoring themselves or use a pest scout. However, the Official Survey (in February) can only be conducted by a Registered Crop Monitor (see section 2. Registered Crop Monitor responsibilities).

The number of trees and fruit sampled (with calyx inspection) depends on the size of the block (see table 1, page 1). The Grower monthly monitoring form (page 8) is the preferred method of maintaining monthly monitoring records but pest scouts may use an equivalent format.

An official survey must also be conducted in February by a Registered Crop Monitor. During the February survey, each tree must be assessed for the presence of Fuller's rose weevil using a beat mat (Qld exempt). A sample of leaves must be inspected for the presence of brown rot, Septoria spot and greasy spot (South Korea requirement only, see table 1 for details).

Table 1. Sampling schedule for critical pests in each block

Area (ha)	Number of trees sampled	Total number of fruit sampled (with calyx removal)	Leaf inspection during Official (Feb) Survey by RCM (South Korea only)
Less than 2	25	50	5 trees per block, 40 leaves per tree = 200 leaves per block
2-3	30	60	
4	35	75	
5-8	50	100	
9-16	75	125	
+1	+5	+5	

1.4 Orchard (or block) freedom for quarantine pests

Some countries require that orchards (or blocks) are surveyed and found free from certain pests. Requirements differ between importing countries.

Table 2. Pests requiring orchard freedom for China and South Korea

China	South Korea
<p>The orchard or the particular block is suspended for the remainder of the season if any of the following pests are detected.</p> <ul style="list-style-type: none"> • Fuller’s rose weevil* • Light brown apple moth* • <i>Phytophthora spp.</i> (Brown Rot) • Fruit rot • Septoria spot 	<p>The orchard or the particular block is suspended for the remainder of the season if any of the following pests are detected.</p> <ul style="list-style-type: none"> • <i>Phytophthora spp.</i> (Brown Rot) • Septoria spot • Greasy spot
<p>* growers may elect to implement a systems approach for FRW and LBAM if the orchard is not free from these pests (see sections 1.6 and 1.7)</p>	

1.5 Critical quarantine pests

The following pests (Table 3) are considered critical quarantine pests for South Korea, China and Thailand. Growers must follow the advice of pest scouts in responding to pest pressures. Documented evidence of monitoring and control measures must be retained by growers.

Refer to the respective Department of Agriculture, Water and the Environment (DAWE) work plans for more comprehensive quarantine pest lists.

Note that these lists are not exhaustive and importing countries may action other pests if detected on arrival. For example, mealy bugs are a common cause of rejections.

Table 3. Critical quarantine pests for South Korea, China and Thailand

Pest	Management Measures		
	China	Thailand	South Korea
Fuller’s Rose Weevil	Surveyed found free (including Qld) OR Systems Approach (see section 1.6). In-field threshold of 0.2 FRW per tree	Systems approach (except Qld) In-field threshold of 0.2 FRW per tree	Consignments inspected and found free
Light Brown Apple Moth	Orchards surveyed and found free OR Systems Approach (see section 1.7)	Consignments inspected and found free	Consignments inspected and found free
Brown Rot (All <i>Phytophthora spp.</i>)	Orchards surveyed and found free	Consignments inspected and found free	Orchards surveyed and found free
Septoria spot	Orchards surveyed and found free	Consignments inspected and found free	Orchards surveyed and found free
Greasy spot	No specific measures	Consignments inspected and found free	Orchards surveyed and found free
Red scale	No specific measures	No specific measures	Consignments inspected and found free

1.6 Fuller's rose weevil systems approach

When do you need to implement a systems approach?

Thailand

The FRW systems approach is mandatory for export to Thailand for all states other than Queensland. If FRW levels are equal to or greater than 0.2 FRW adults per tree, the block will be suspended for export to Thailand for the remainder of the season.

China

For export to China, growers have two options:

1. Orchard/block freedom — if blocks are surveyed and found free from FRW (eggs or adults) during monthly monitoring and the Official (February) survey, no measures are required. This option is primarily for Queensland orchards and other isolated orchards.

OR

2. Systems approach - if FRW (eggs or adult weevils) are detected at any time during crop monitoring, the systems approach must be implemented. If FRW levels are equal to or greater than 0.2 FRW adults per tree, the block will be suspended for export to China for the remainder of the season.

The FRW systems approach includes:

1. Orchard risk assessment

Many blocks can genuinely claim orchard freedom due to their isolation. All new blocks (except QLD) registering for the export program should be assessed with a beat-mat and other methods to determine the status of FRW prior to entering the program. If FRW (eggs or adults) are detected, the FRW systems approach should commence immediately.

2. Sanitation and exclusion

FRW adults don't travel far. Growers should be aware that dispersal between orchard blocks, properties and districts relies on human assistance. Dispersal can occur in the soil with new plantings, or on clothing, machinery and equipment moving into established orchards from infested blocks.

3. Skirting

Trees must be skirted to ensure that low foliage or fruit does not touch the ground or come into contact with weeds. Skirt height must take into account the future sagging of branches as a result of fruit growth. Skirts should be at least 50 cm high at the February survey to allow for and easy trunk treatment (if applied) and inspection for weeds. There must be less than one in twenty trees with branches contacting the ground during the official February survey.

4. Weed control and orchard hygiene

Weed control must be maintained to prevent bridging into the canopy. Orchard blocks must be inspected frequently enough to detect and combat weed regrowth before weeds contact the tree foliage. Prunings, tumbleweeds and packaging material must be kept out of the orchard as they are easily blown under trees where they create bridges for FRW adults.

5. Chemical control measures

If Fuller's rose weevil is detected at any stage during monitoring, chemical control measures should be applied.

For export to Thailand, any chemical approved for use in Australia to control FRW on citrus, will be applied even if only a single FRW adult or egg is detected.

For export to China, an informed decision may be made on whether or not to apply chemical control measures.

A range of chemical control measures are currently available which include systemic insecticides, foliar sprays and trunk-band sprays.

6. Ongoing monthly FRW monitoring

Monthly monitoring for FRW must continue from December until harvest (along with other pests) to reduce the risk of eggs being present on exported fruit.

Branch shaking with a beat mat is required during the February survey and fruit inspections must be carried out in other months. Place a 1m² white shade-cloth mat under a low branch and shake vigorously six times. Inspect the mat for the presence of FRW adults.

Fruit will often fall to the ground when branch shaking and these should be inspected under the calyx for the presence of FRW eggs.

7. February verification survey

Growers must engage the services of a Registered Crop Monitor during February to verify the FRW status of orchard blocks China (orchard freedom or systems approach with less than 0.2 FRW per tree), Thailand (systems approach with less than 0.2 FRW per tree) have been fulfilled. However, it is not the crop monitor's responsibility to determine if orchards meet the requirements. It is the packinghouse's responsibility to review crop monitoring records before making a decision to supply fruit to each respective market.

Crop monitors will conduct an orchard inspection, sight monitoring and control records and complete the Official Survey Report in Citrus Australia's on-line system.

Documented evidence must be retained and may be audited by DAWE or the overseas authorities.

Note that the February survey is not the final step in the process. Monitoring and control must continue until the time of harvest.

1.7 Management of light brown apple moth (China only)

For management of light brown apple moth, growers have two options:

1. Orchards must be surveyed and found free from light brown apple moth on a monthly basis.
- OR**
2. Growers may implement a systems approach. The systems approach includes:
 - Deployment of specific LBAM traps during spring at a rate of one trap per registered block
 - Monthly monitoring for egg masses and caterpillars (and record keeping) from December until harvest
 - appropriate chemical or biological control measures.

MEALY BUGS

Golden mealybug <i>(Nipaecoccus aurilanus)</i>	Quarantine pest for China
Pacific mealybug <i>(Planococcus minor)</i>	Quarantine pest for China & South Korea
Rastrococcus mealybug <i>(Rastrococcus truncatispinus)</i>	Quarantine pest for Thailand
Hibiscus mealybug <i>(Maconellicoccus hirsutus)</i>	Quarantine pest for South Korea
Spherical mealybug <i>(Nipaecoccus viridis)</i>	Quarantine pest for South Korea
Citrophilous mealy bug <i>(Pseudococcus calceolariae)</i>	Quarantine pest for South Korea
Longtailed mealybug <i>(Pseudococcus longispinus)</i>	Quarantine pest for South Korea

Description

Mealy bugs are slow moving, soft bodied, oval-shaped insects. They are covered with a thin coating of white, mealy wax, which extends into filaments around the edge of the body. Adults are generally 3-4 mm long. Mealy bugs commonly crowd together in sheltered sites.

Damage

The main economic damage caused by mealybugs is from the downgrading of fruit quality due to sooty mould fungus growing on the honeydew.

Monitoring

Examine sheltered sites on each tree including between leaves and where fruit touch. Remove the calyx of each fruit and examine for the presence of egg sacs, nymphs, adults, and parasitised mealy bugs using a hand-lens. If honeydew and sooty mould are present, it is likely that a substantial mealy bug population exists.



RED SCALE

(Aonidiella aurantii)

Quarantine pest for South Korea

Damage

Attacks twigs, leaves, branches, and fruit. Damage is most likely to occur in late summer and early autumn.

Monitoring

Inspect the surface of fruit. The scale cover of the female is circular (about 2 mm diameter), whereas that of the male is elongated. The colour of the scale cover changes from white in the first stage to reddish brown in later stages.



LIGHT BROWN APPLE MOTH

(Epiphyas postvittana)

Damage

In citrus, light brown apple moth (LBAM) causes fruit drop and a 'halo' type scar around the stem end of the fruit.

Monitoring

When young fruitlets (<10 mm) are abundant, most larvae establish feeding sites in the clusters of fruit, among leaves and in flower remnants. During the young fruit stage (<40 mm), most larvae feed under the calyces of individual fruit. When only mature fruit are available, most larvae are found in amongst young leaves. Larvae of all ages construct silken shelters at the feeding site. When disturbed, the larva will wriggle vigorously backwards.



FULLER'S ROSE WEEVIL

(Pantomorus cervinus)

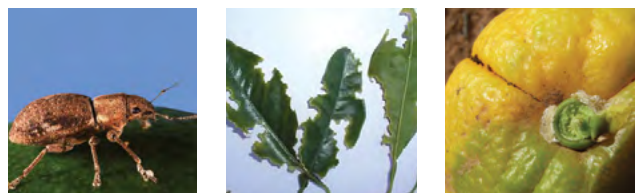
Damage

Foliage near the trunk or touching the ground is most likely to be damaged. Fuller's rose weevil (FRW) adults chew leaf margins, leaving a serrated edge. The presence of eggs under the calyx will lead to rejections in South Korea, China and Thailand.

Monitoring

FRW eggs are yellow in colour and glued together in yellowish 'papery' clusters of 20–30. FRW adults are about 8mm in size with two pale markings on the side of its body (arrowed), and a short snout. The most effective way of monitoring FRW in orchards is by beating limbs over a 1m² piece of white shade cloth.

See Section 1.6 for more details on FRW management program.



ORANGE FRUIT BORER

(Isotenes miservana)

Damage

Orange fruit borer is of sporadic importance to late maturing citrus in Queensland. Larvae bore into fruit at the calyx end or where fruit touch causing it to drop. Larvae roll flower buds and young leaves together to form feeding shelters.

Monitoring

The adult moth is grey with a wingspan of 20 mm. Mature larvae are up to 24 mm long, brown with two longitudinal brown stripes and a dark head capsule.

Bore holes can be small (3mm) and can sometimes be seen as a prematurely coloured spot on green fruit. Eggs appear as overlapping clusters. Check for signs of webbing or gouging of fruit, especially between touching fruit.



OTHER BORERS

While not generally considered pests of citrus in Australia, blastobasid fruit borer and sorghum head caterpillar are considered quarantine pests for South Korea and China.



BROWN ROT

(Phytophthora citricola, Phytophthora syringae and hibernalis)

The common causes of brown rot in Australian citrus orchards are *Phytophthora citricola*, *Phytophthora hibernalis* and *Phytophthora syringae*.

Damage

Yellowing of the leaves, twig dieback, death of the root system, infection of the trunk, deep rot in fruit. The decay is first observed as a light brown discoloration of the rind. Initially, the firm, leathery lesions have a water-soaked appearance, but they soon turn soft and have a tan to olive brown colour with a distinctive pungent smell.

Monitoring

On oranges and mandarins, grey/brown firm rots form. On grapefruit and lemons the rot is yellow/brown. Leaves may have grey/brown to dark brown tip and edges and may fall when green.



GREASY SPOT

(Mycosphaerella citri)

Damage

High levels of leaf infection can result in leaf drop and overtime reduced tree vigour. Fruit staining / rind blotch is infrequent.

Monitoring

First appears as small black specks up to 0.5 mm in diameter, sometimes with a chlorotic halo, on the underside of leaves 4-6 months old. With time, spots take on a darker greasy appearance. Chlorosis associated with the leaf spots extends to the upper leaf surface. Specks on the lower surface enlarge into slightly raised greasy yellow brown to black blisters 1-3 mm in diameter that darken with age.



SEPTORIA SPOT

(Septoria citri)

Damage

On infected fruit exposed to frosts, spots may enlarge and join to produce brown/black patches.

Monitoring

Small, round depressions that extend no deeper than the rind surface (1-2 mm diameter) will appear on fruit. Pits are light tan with a narrow greenish margin, becoming reddish-brown as the fruit matures. On infected leaves, small blister-like brown/black spots with a yellow halo develop on the lower surface.



QUEENSLAND FRUIT FLY

(*Bactrocera tryoni*)

MEDITERRANEAN FRUIT FLY

(*Ceratitis capitata*)



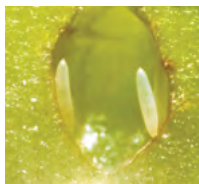
Damage

Adults lay eggs ('sting') in the fruit and the larvae feed in the flesh. Affected fruit are readily recognised since rots develop rapidly and the skin around the sting marks becomes discoloured. Queensland fruit fly damage is more severe during mid and late summer than at other times.

Monitoring

In some states of Australia, fruit fly monitoring is a state department responsibility. The recommended trap contains a synthetic attractant combined with a fumigant insecticide. Inspect traps at weekly intervals in spring, summer and autumn and fortnightly in winter.

Inspect fruit for obvious signs of damage. All species of fruit fly have similar features with a large rounded abdomen tapering to a small back coloured head. Larvae are up to 8 mm in length and when disturbed, curl into a "C" shape to hop/jump. Male lure traps may be placed in each block at a rate of one per 10-20 hectare as an additional monitoring measure.



1.8 Annual orchard registration process

An application must be completed for each accredited property (orchard) applying for export to South Korea, China or Thailand. Citrus Australia maintains an online system for orchard applications. The system opens in November each year.

DAWE will issue an Industry Advice Notice calling for registrations. New entrants to the program must email Citrus Australia at registrations@citrusaustralia.com.au in early November to obtain a username and password for Citrus Australia's on-line application system.

1. The application process starts with the Citrus Tree Census on-line form.
2. Ensure that you nominate YES to "Registering for South Korea, China, Thailand?" on the tree census form.
3. After completing the tree census and nominating to export, the system will generate a second email (please monitor your emails including your SPAM or JUNK folder). Follow the instructions in your email to create the orchard application.
4. The system will ask you to:
 - nominate which blocks you would like included for export
 - nominate your primary packing house
 - nominate a Registered Crop Monitor
 - upload an orchard map (the map must clearly identify each block with a unique identifier corresponding with the block on the application).

Growers already in the system from previous years will be sent an email with instructions at the start of November.

2. REGISTERED CROP MONITOR RESPONSIBILITIES

Registered Crop Monitors must be trained and assessed to qualify for registration. Training is coordinated by Citrus Australia via an on-line training system at Tocal College. A certificate of training completion must be retained.

Email Citrus Australia at registrations@citrusaustralia.com.au for training program details. DAWE will maintain a record of all Registered Crop Monitors.

Official February survey

Registered Crop Monitors will visit growers between February 1 and February 28 each season to inspect orchards and verify documentation.

Documentation

Registered Crop Monitors will:

- sight monthly IPM monitoring records for each block
- sight records of in-field controls (e.g. spray diary) for each block.

Orchard survey

Registered Crop Monitors will survey all export blocks according to the survey methodology (Table 1, page 1) to verify that:

1. blocks are free of particular pests and diseases (China - 5 pests and diseases), (South Korea – 3 diseases) (see Table 2, page 2)
2. detection levels of FRW do not exceed the threshold for China and Thailand (0.2 or more adults per tree) by use of a beat mat (Qld exempt)
3. trees are skirted and weeds have been adequately controlled (mandatory for Thailand, Qld exempt). A tolerance of 1 in 20 trees in contact with the ground is acceptable.

Registered Crop Monitors will complete the February official survey report using Citrus Australia's on-line registration system before 3 March each season.

3. PACKING-HOUSE RESPONSIBILITIES

DAWE will issue an Industry Advice Notice calling for applications in October each year.

Packing-houses must:

1. apply for accreditation with DAWE using Citrus Australia's on-line registration system.
2. ensure that their growers have entered and identified each block in the on-line registration system
3. ensure that their growers have uploaded an orchard map that clearly identifies each block with a unique identifier corresponding with the block on the application
4. review the Official Survey Report from the Registered Crop Monitor in Citrus Australia's on-line registration system (after February)
5. review the block status in Citrus Australia's on-line registration system for each nominated orchard/block prior to packing.

Orchard suspension for China

Packing-houses should withdraw nominated orchard blocks for export to China if any of the following pests and diseases are detected at any time in the season.

- *Phytophthora spp.* (Brown Rot)
- Septoria spot

If light brown apple moth is detected but the systems approach has been applied (see section 1.7), the block is still eligible for export to China.

Packing-houses should withdraw orchard blocks for export to China if FRW detection levels are equal to or greater than 0.2 weevils per tree or if the systems approach has not been implemented adequately.

Orchard suspension for South Korea

Packing-houses should withdraw nominated orchard blocks for export to South Korea if any of the following pests are detected.

- *Phytophthora spp.* (Brown Rot)
- Septoria spot
- Greasy spot

Orchard suspension for Thailand

Packing-houses should withdraw nominated orchard blocks for export to Thailand if FRW detection levels are equal to or greater than 0.2 weevils per tree.

To withdraw blocks after the close of registration (March each year) email Citrus Australia at registrations@citrusaustralia.com.au.

3.1 Packing house inspections

Packing houses are required to take steps to inspect fruit to ensure that it is free from pests before being presented for export.

Grower lot inspection for Fuller's rose weevil (Queensland exempt, for Thailand only)

A sample of fruit from each grower lot must be inspected for the presence of FRW eggs and other pests prior to entering the packing line. This is mandatory for Thailand. A 600-unit inspection rate will apply to each daily delivery of citrus fruit from each registered block/orchard (the inspection lot).

Sampling should be taken as uniformly as possible across all bins in each inspection lot.

The samples may be taken in the orchard and delivered to the packing house with the lot.

The inspection will be undertaken by the packing house quality controller and must include a thorough examination under the calyx of at least 60 fruit for the presence of FRW eggs. All results, including negatives, must be recorded and made available to DAWE upon request.

In-line or endpoint inspection (Queensland exempt, all countries)

Packing houses are also required to carry out a 600 unit in-line or end point inspection for all three markets. Packing houses in all states (except Queensland) must remove the calyces of 60 fruit to examine for the presence of Fuller's rose weevil eggs.

If any evidence of FRW is found during either inspection, all fruit from the block will be excluded from export to South Korea, China and Thailand for the remainder of the season.

Note that these inspections do not replace the phytosanitary inspections that are conducted by Authorised Officers in order to issue the Phytosanitary Certificate.

4. DAWE RESPONSIBILITIES

Each season, DAWE will issue an Industry Advice Notice calling for registrations. DAWE will audit all packing houses during each export season and may also audit growers and Registered Crop Monitors.

Grower monthly monitoring form

Orchard: _____

Address: _____

Crop monitor: _____ Date: _____



Block name Size (ha) (Referenced to map)	Number of trees Surveyed (Table 1 KCT manual)	Number of fruit Surveyed (Table 1 KCT manual)	FRW (number)	LBAM (Y/N)	Mealy bugs (Y/N)	Scales Red scale Black thread scale Whitefly (Y/N)	Fruit borers Blastobasid Sorghum head Carob moth (Y/N)	Fruit fly damage (Y/N)	Diseases: (Y/N)
Block name: _____ ha									Septoria: Phytophthora: Greasy spot:
Block name: _____ ha									Septoria: Phytophthora: Greasy spot:
Block name: _____ ha									Septoria: Phytophthora: Greasy spot:
Block name: _____ ha									Septoria: Phytophthora: Greasy spot:
General comments:									